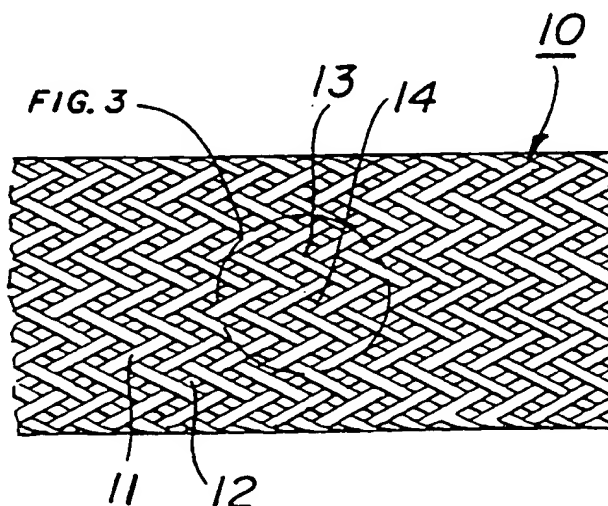




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(21) International Application Number: PCT/US91/01303 (22) International Filing Date: 28 February 1991 (28.02.91) (30) Priority data: 492,802 12 March 1990 (12.03.90) US (71) Applicant: THE BENTLEY-HARRIS MANUFACTURING COMPANY [US/US]; 241 Welsh Pool Road, Lionville, PA 19353 (US). (72) Inventor: KITE, J., Sellers, III ; 721 Invermess Drive, W. Chester, PA 19380 (US). (74) Agents: FREE, Albert, L. et al.; Synnestvedt & Lechner, 2600 One Reading Center, 1101 Market Street, Philadelphia, PA 19107 (US).		(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), SU. Published <i>With international search report.</i>

(54) Title: BRAIDED PRODUCT AND METHOD OF MAKING SAME

**(57) Abstract**

An expandable braided product having greatly reduced tendency to splay at its ends when cut is provided by coating the braided product (10) with a thin layer of elastomeric material which provides the desired anti-splaying property, while retaining the expandable characteristic whereby the product expands laterally when compressed longitudinally and when released returns to its original size and shape.

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1 BRAIDED PRODUCT AND METHOD OF MAKING SAME

Field of the Invention

 This invention relates to monofilament braided product and to methods for making same. It relates more particularly to braided product made up of monofilaments, typically of a resilient engineered plastic material and typically (but not necessarily) in the form of a tubular sleeve.

Background of the Invention

10 One known form of braided product is the Expando™ self-fitting protective oversleeve made by Bentley-Harris Manufacturing Co. of Lionville, Pennsylvania. This tubular sleeve is expandable in that, when the ends are pushed toward each other it expands in diameter, and when they are released
15 it returns to its original shape and size. This enables it to be pulled or pushed over objects of different diameters, including diameters greater than the unstressed or "rest" diameter of the sleeve, and also enables it to accommodate expansion, bending and twisting of hoses or wires which may
20 run through it. This expandable braided product also exhibits a "spring-back" or "memory" characteristic, whereby it tends to return to its rest diameter when released from longitudinal forces. Such expandable braided sleeving has been widely used, for example to protect, and/or dress,
25 wiring harnesses and hose assemblies.

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1 One difficulty with the typical braided product of
the expandable type is that when the braid is cut in an
ordinary manner, as by scissors, the ends of the braid will
tend to unravel or splay, the braiding coming apart for a
5 substantial distance back from the cut ends. This is
particularly troublesome when an end of a braided sleeve must
be forced over a large-diameter object, causing the
monofilaments to splay and therefore no longer provide the
desired type of tight fit on the smaller-diameter contents of
10 the tubular covering; in addition such splaying is
cosmetically very undesirable.

There are currently three principal ways in which
this problem has been addressed, as follows:

15 (1) Coat the braided product with a continuous
coating. This eliminates the splaying, but also restricts
the expandability of the braid and therefore its ability to
slide over, or wrap around, an object with full conformity to
a variable cross-section of the object. Such a construction
also prevents one from "breaking out" a branching wire from
20 the interior of braided tubing, as is sometimes desirable.

 (2) Heat-set the braided product. Heating the
completed product will put a slight set into the braid, but
with even slight mechanical expansion the ends will unbraid
and splay out again.

25 (3) Cut the braid with a hot knife or wire. With
most plastic braidings, the sleeve can be cut through with a
hot knife or wire, thereby fusing the monofilaments to each
other to prevent the braid from fraying or unraveling.
However, such end treatment will fix the diameter at that set
30 by the fusing of the end of the tubular braid, and thereby

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- 1 prevent the braid from expanding readily to receive a large
object. Further, this method requires use of special hot
melt devices to provide such cutting of the braid, and
therefore is not useful for field installations of the sleeve
5 where no such special tools are available.

Accordingly, it is an object of the present
invention to provide a new braided product and method of
making it, which minimize such fraying while retaining the
natural expansion and contraction characteristics of the
10 expandable type of braided product.

It is also an object of the invention to provide
such method and apparatus in which the treatment providing
the above described advantageous characteristics is readily
and inexpensively performed, and in which the user can cut
15 the resultant braided product to the desired length without
having to use any special cutting or bonding tools.

Summary of the Invention

These and other objects of the invention are
achieved by the provision of a monofilament braided product
20 in which the braided product is at least partly coated with
an adherent, preferably elastomeric, material extending form
at least some over-weave monofilaments to their associated
underweave monofilaments at their respective cross-overs,
permitting the monofilaments to pivot with respect to each
25 other as required to retain the desired expandable
characteristics, while preventing splaying. The coating is

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- 1 preferably of an elastomeric material, and preferably does not completely cover the openings between the monofilaments.

The coating is preferably applied by passing the braid continuously through a liquid bath containing the
5 coating material in flowable form, and then solidifying the coating in position on the braided product. The viscosity of the liquid of the coating is such that it provides enough material in the proper places to fix the monofilaments against end splaying, while retaining the ability of the
10 filaments to pivot with respect to each other, and the consequent ability of the sleeve to expand and shrink in cross-sectional size. If the coating does initially extend across the openings between the monofilaments, it is preferably such as to break upon longitudinal compression of
15 the braided material, although with a sufficiently compliant elastomeric material this is not always necessary.

In this manner there is provided a braided product and method of making it which prevent splaying of the end of the braid without materially adversely affecting the
20 expandable characteristics of the braid.

Brief Description of Figures

These and other objects of the invention will be understood from a consideration of the following detailed description taken in connection with the accompanying
25 drawings, in which:

Figure 1 is a side view of a section of expandable tubular product which has been cut by an ordinary pair of

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1 scissors, and mechanically expanded at the cut end, and which exhibits substantial splaying at its end;

Figure 2 is a side view of a section of expandable braided product made in accordance with the invention, cut at
5 its end with an ordinary pair of scissors and then subjected to a similar expanding procedure.

Figure 3 is an enlarged fragmentary view of the exterior of the braided product of Fig. 2;

Figure 4 is a cross-sectional view taken on lines
10 4-4 of Figure 3, showing the braided product of the invention after the coating has been formed therein;

Figure 5 is a cross-sectional view taken along lines 5-5 of Fig. 3; and

Figure 6 is a cross-sectional view like Figure 5,
15 but illustrating the condition in which a break exists in the coating near each cross-over of the braid.

Detailed Description of Specific Embodiments

Referring now to the embodiment of the invention shown in the drawings by way of example only, and without
20 thereby limiting the scope of the invention, Figure 1 shows a section of expanded, braided tubular sleeving 8, constructed in accordance with the prior art and exhibiting undesired splaying of the monofilaments at its end 9. Figure 2 shows a
length of expandable, braided, tubular sleeving 10 in
25 accordance with the present embodiment of the invention. It is made up of monofilaments such as 11, 12, 13, 14 in a simple single-strand two-over, two-under braid pattern. Each monofilament in this example is of engineered plastic, for example nylon or polyester, and is substantially rectangular

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1 in cross-section. The monofilaments are covered with an
adherent elastomeric coating 16. In some cases, particularly
after expansion and contraction of the braid by pulling and
pushing of its ends, the coating may contain a break where
5 one monofilament crosses another, as indicated by the break
lines such as 20, 21 in Fig. 6.

In this preferred embodiment of the invention the
coating does not decrease substantially the areas of the
openings such as 30, 31 between the monofilaments, so that
10 space remains for the filaments to pivot at the cross-overs,
one with respect to its adjacent neighbor, during expansion
and contraction of the sleeve, according to the usual
characteristic of such expandable braids. The elastomeric
coating tends to fix the positions of the cross-overs, but
15 being elastomeric, it permits the necessary pivoting of the
monofilaments with respect to each other. This fixing action
of the elastomeric material prevents the ends from splaying,
as is important for the reasons pointed out above. The
retention of the openings such as 30, 31 also permits a wire
20 or the like to be extracted and passed outwardly from the
sleeve if so desired.

While there may be a variety of methods by which
the coating may be applied, it is preferred to accomplish it
by passing a continuous sleeve of the braided material
25 through a bath of the coating material and then drying it in
an oven.

One presently-preferred example of the improved
braided product and of a method for making it, is as follows:

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1 A continuous, expandable braided tube of about
9.5x10⁻³ meters rest diameter is made in conventional manner
from 48 monofilaments of 100 denier nylon, each monofilament
about 30 mils wide and about 10 mils in thickness; the
5 braided tubing is typically coiled on a spool in long
lengths, e.g. 609.6 meters lengths. The tubing from the
spool is then run lengthwise downward into and through a bath
of the coating material, continuing upwardly therefrom
through a hot-air oven typically operating at about 150°C.

10 The liquid coating material may be resorcinol
formaldehyde, with a viscosity of 15,000 centipoises or less
so that it will coat the monofilaments in the braid without
closing the openings between them. Preferably the tubing is
subjected to stretching while passing through the bath, and
15 until drying of the coating is complete.

The resultant braided tubing can be cut to length
with ordinary scissors, and will then exhibit minimal
tendency toward splaying. Nevertheless, when longitudinally
compressed it will increase its diameter and when stretched
20 it will regain its original diameter, and it will also
exhibit memory in that, when unstressed, it tends to return
to the diameter and length it had before compression.

In general, the invention is applicable to a wide
variety of sizes, shapes and materials of braids and of
25 monofilaments, including monofilaments of round cross-
section; it is also of wide applicability with respect to the
number of monofilaments in the braid. While many important

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1 applications of the invention involve a tubular braid, the
invention is also useful in making flat, mat-like expandable
braid products. Also, while the coating materials is
preferably elastomeric, at least some of the advantages of
5 the invention may be realized by using a non-elastomeric
material for the coating which does not bond the filaments
rigidly together, but instead fractures upon compression and/
or stretching of the braid, leaving low walls of coating
material on each side of each monofilament at each cross-over
10 to provide a positioning channel, or at least a high-friction
surface, which resists the type of displacement of the
monofilaments which occurs during splaying. A similar effect
exists in some cases when an elastomeric material is used
which fractures during stretching and/or compression. Other
15 coating procedures may also be used, so long as they do not
result in such a thick, pervasive coating that the
monofilaments cannot pivot, each with respect to its
neighbor, as is required to exhibit the desired expandable
characteristic.

20 While the invention has been described with
particular reference to specific embodiments thereof in the
interest of complete definiteness, it may be embodied in a
variety of forms diverse from those specifically shown and
described, without departing from the spirit and scope of the
25 invention.

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WHAT IS CLAIMED IS:

1. An expandable monofilament braided product, comprising a plurality of braided monofilaments and a coating of adherent solid material on said filaments holding said
5 filaments in their proper relative positions to prevent splaying of the ends of said braid while permitting them to pivot with respect to each other at each of their cross-overs so as to retain the expandable characteristics of said braided product.

10

2. The braided product of claim 1, wherein said adherent solid material is elastomeric.

3. The braided product of claim 2, wherein said coating leaves the openings between said monofilaments substantially free of said coating.

15

4. The braided product of claim 2, wherein said material is selected from the group consisting of resorcinol formaldehyde and acrylic latex.

5. The braided product of claim 1, wherein said monofilaments are of engineered plastic material.

20

6. The braided product of claim 5, wherein said monofilaments are of nylon or polyester.

7. The braided product of claim 1, wherein said coating extends over substantially all of the exposed surfaces of said monofilaments throughout the length of said

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1 braided product.

8. The braided product of claim 1, wherein said coating is from about 1 to about 20 mils in thickness.

5 9. The method of treating a monofilament expandable braided product to reduce its tendency to splay at its ends while retaining its expandable properties, comprising:

15 forming a solid coating of adherent solid material on said monofilaments of said braid to hold them in their proper relative positions and thereby minimize the tendency toward splaying at the ends of said braid, said coating permitting said monofilaments to pivot with respect to each other at their cross-overs so as to retain the expandable characteristics of said braided product.

20 10. The method claim 9, wherein said material is elastomeric.

11. The method of claim 10, wherein said material is selected from the group consisting of resorcinal formaldehyde and acrylic latex.

25 12. The method of claim 9, wherein said coating is from about 1 to about 20 mils in thickness.

13. The method of claim 9, wherein said forming of said coating comprises passing said braid through a bath of said material in its flowable form, and thereafter allowing
30 said material to solidify on said braid.

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1 14. The method of claim 13, wherein said material
of flowable form has a viscosity not substantially greater
than 15,000 centipoises.

5 15. The method of claim 9, wherein said forming of
said solid coating comprises coating substantially all
exposed surfaces of said monofilaments with said material in
flowable form without filling the openings between said
monofilaments.

10 16. The method of claim 9, wherein said coating
extends over the openings between said monofilaments.

15 17. The method of claim 9, comprising forming said
solid coating over said monofilaments and the openings
between them, and thereafter compressing said braided product
to break open said coating in the regions where it covers
said openings.

18. The braided product made by any of claims 10-
17.

FIG. 1
(PRIOR ART)

1/2

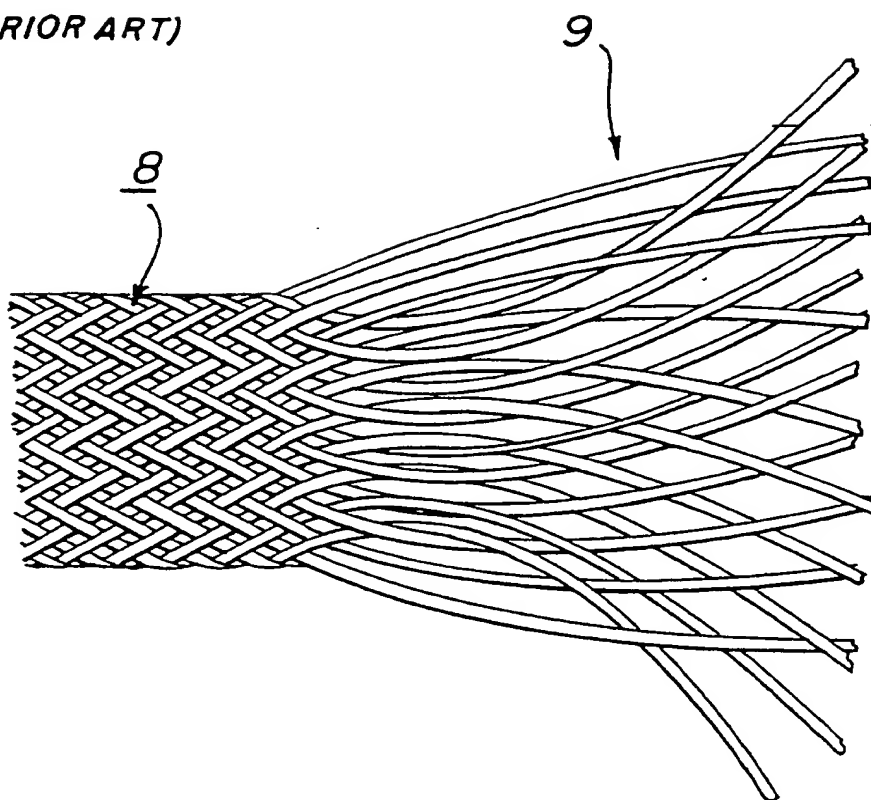
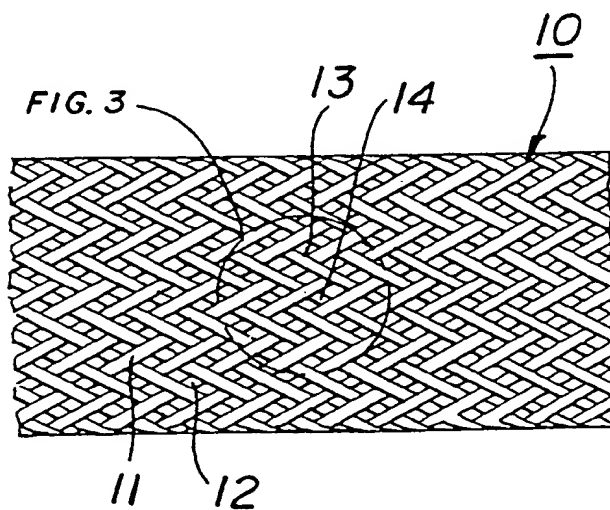


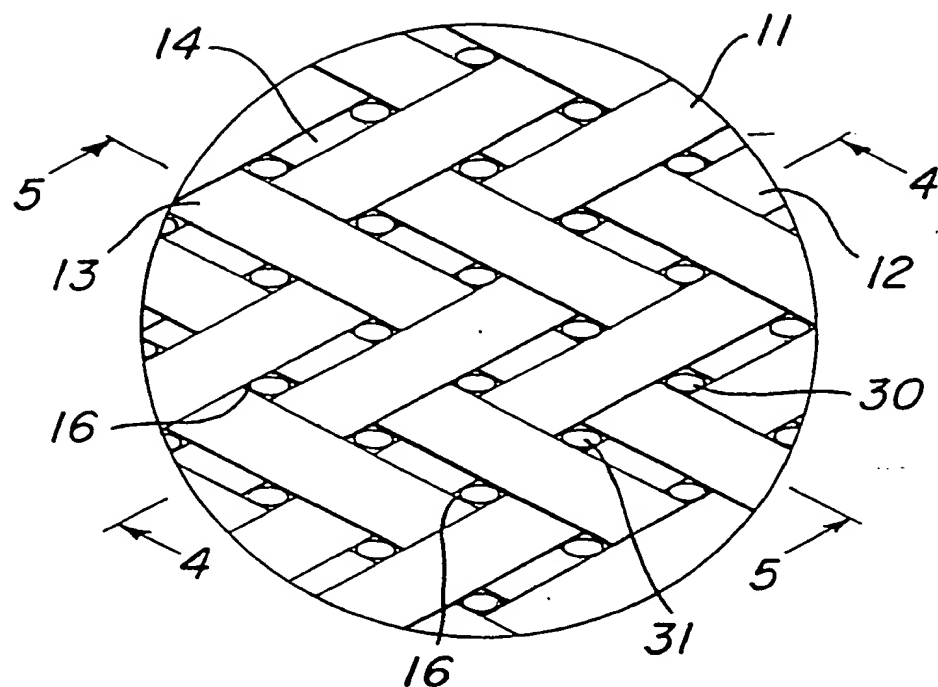
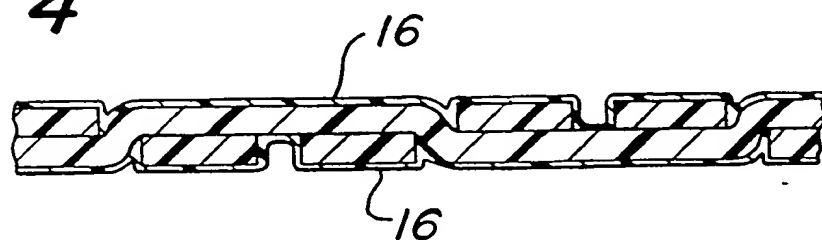
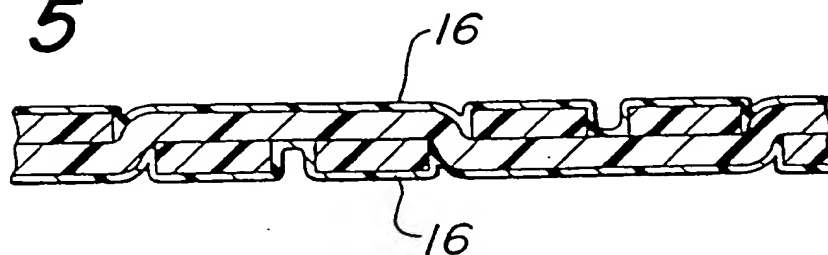
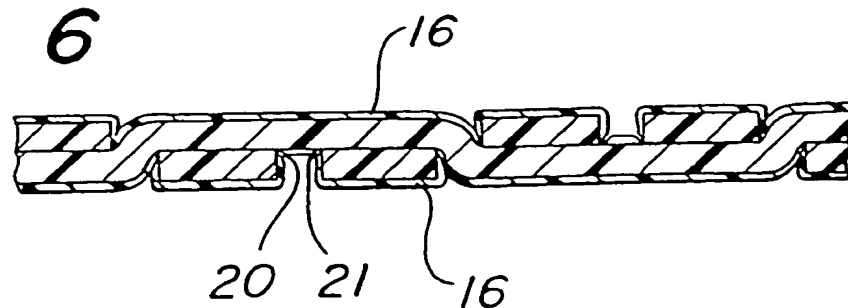
FIG. 2



SUBSTITUTE SHEET

FIG. 3

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**FIG. 4****FIG. 5****FIG. 6**

SILICITITE SHEET

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/01303

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC INT. CL(5): D04C 1/02, 1/06 U.S. CL: 87/1, 8, 9																	
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched ⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 25%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="padding: 5px;">U.S.</td> <td style="padding: 5px;">87/1, 8, 9 428/37, 222</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸</div>			Classification System	Classification Symbols	U.S.	87/1, 8, 9 428/37, 222											
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category [*]</th> <th style="border-bottom: 1px solid black;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 15%; border-bottom: 1px solid black;">Relevant to Claim No. ¹³</th> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">US, A, 2,393,530 (HARRIS) 22 JANUARY 1946 see entire disclosure.</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-18</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">US, A, 3,048,078 (KAPLAN) 07 AUGUST 1962 see entire disclosure.</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-18</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">US, A, 2,977,839 (KOCH) 04 APRIL 1961 see entire disclosure.</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-18</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">US, A, 4,754,685 (KITE) 05 JULY 1988 see entire disclosure.</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-18</td> </tr> </table>			Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	Y	US, A, 2,393,530 (HARRIS) 22 JANUARY 1946 see entire disclosure.	1-18	Y	US, A, 3,048,078 (KAPLAN) 07 AUGUST 1962 see entire disclosure.	1-18	Y	US, A, 2,977,839 (KOCH) 04 APRIL 1961 see entire disclosure.	1-18	Y	US, A, 4,754,685 (KITE) 05 JULY 1988 see entire disclosure.	1-18
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<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>[*] Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 48%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Δ" document member of the same patent family</p> </div> </div>																	
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of the Actual Completion of the International Search</td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of Mailing of this International Search Report</td> </tr> <tr> <td style="padding: 5px;">04 JUNE 1991</td> <td style="text-align: center; padding: 5px;"> <div style="font-size: 1.2em; font-weight: bold;">24 JUN 1991</div> </td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;">International Searching Authority</td> <td style="border-bottom: 1px solid black; padding: 5px;">Signature of Authorized Officer</td> </tr> <tr> <td style="padding: 5px;">ISA/US</td> <td style="text-align: center; padding: 5px;"> W. J. VanBalen </td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	04 JUNE 1991	<div style="font-size: 1.2em; font-weight: bold;">24 JUN 1991</div>	International Searching Authority	Signature of Authorized Officer	ISA/US	 W. J. VanBalen							
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